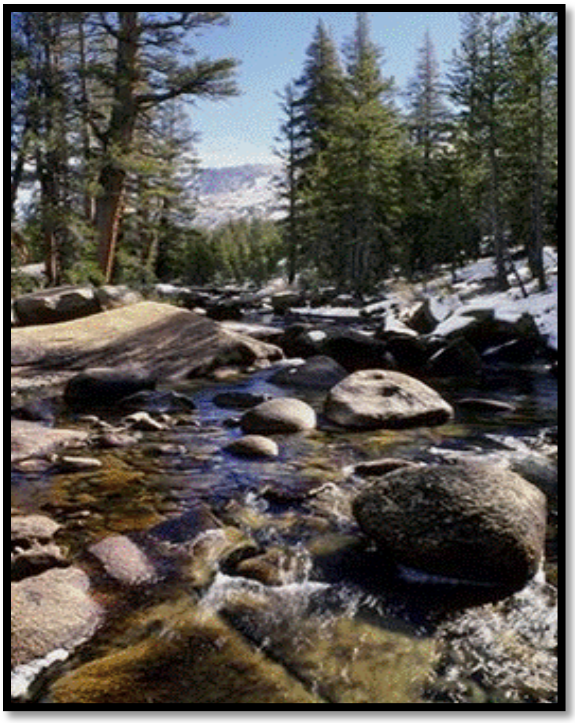
Chapter 5
Region Description



The CABY region consists of four watersheds (Cosumnes, American, Bear, and Yuba) and 12 subwatersheds situated within the north central Sierra Nevada in California. The area extends from the northern parts of the Yuba River watershed in Yuba, Nevada, and Sierra Counties to the southern part of the Cosumnes River watershed in Amador County. The CABY region land area comprises 4,351 square miles, or about 30 percent of the Mountain Counties Area as defined in the State of California Department of Water Resources (DWR) Water Plan Update (DWR 2009). All four watersheds include headwaters that drain large volumes of water into the Sacramento and Mokelumne Rivers, ultimately serving the Sacramento Delta ecosystems. The CABY region encompasses only 2.4 percent of California's total land base and is home to a small fraction of California's population, but its significance both ecologically and economically cannot be measured by its size or number of residents. Further, it is a significant source-water contributor to out-of-region uses, including Delta ecological needs.

The CABY region is geographically diverse with a broad range of elevation, slope, aspect, and soils characteristics. The Plan area ranges in elevation from 400 feet at Folsom Reservoir at the western border to over 9,000 feet at the crest of the Sierra Nevada at the eastern border. The region's geographic diversity combined with variations in average temperatures and precipitation support a wide variety of vegetation communities. Many of these habitats are considered ecologically sensitive; the region supports 121 species and nine habitats of special concern.[1]

At the same time, the CABY region provides significant economic resources to the entire state, serving as the source headwaters and contributing a significant portion to California's water supply, including flows for the Bay-Delta system, the Central Valley Project, and the State Water Project. Moreover, the CABY watersheds generate thousands of megawatts of hydroelectric energy serving communities far beyond the region through California's electrical grid system.

This section presents an overview of the environmental setting in the CABY region that is critical to managing natural resources, as well as understanding the sometimes competing interests within the region. The section also presents an overview of the internal boundaries and social and cultural makeup, demographic, and economic attributes of the region.

The previous CABY 2007 Integrated Regional Water Management Plan (IRWMP) includes detailed descriptions of various geographic conditions that remain unchanged. Certain broad overview topics

[1] California Department of Fish and Game 2012

such as geologic history of the Sierra Nevada, soils in the CABY region, and Native American history are incorporated by reference from the 2007 IRWMP. Additionally, much of this information is included in Appendix D. Finally, the topics of water quality, major water-related infrastructure, and land use are further described in Chapters 6, 7, and 8. Issues and Objectives are discussed in Chapter 9.

5.1 CABY Region Watersheds and Water Systems

The CABY planning region consists of the upper watersheds of the Cosumnes, American, Bear, and Yuba Rivers which combine to form a major drainage area of the western slope of the Sierra Nevada range, from the mountain crest to the Central Valley. The CABY region eastern boundary is defined by the headwaters of the four rivers that flow west from the Sierra Crest; the western boundary follows the 400-foot elevation line, creating a purposeful delineation between upper and lower watersheds, and the northern and southern boundaries are defined by the Yuba and Cosumnes watersheds, respectively (see Figure 5-1).

The principal rivers in the planning region are shown in Figure 5-2, and described fully in sections 5.1.4 and 5.1.5 below. The combined water storage capacity of the CABY region watersheds represents a significant portion (nearly 30%) of the total water storage capacity in the Mountain Counties Region which generates 65 percent of the water supply for California (DWR 2009). Major hydroelectric and flood-control reservoirs include: French Meadow, Hell Hole, Union Valley, New Bullards Bar, Englebright, Folsom, Combie, Fordyce, Bowman, Camp Far West, Spaulding, Rollins, Union Mine, Icehouse, Loon Lake, Gerle Creek, Forebay, Silver Lake, and Caples Lake Reservoirs. Major lakes and reservoirs used primarily for local water supply include: Jackson Meadows, Merle Collins, and Jenkinson Lake. There are also hundreds of small, natural lakes within the CABY region situated primarily within the upper reaches of the watersheds.

Figure 5-1

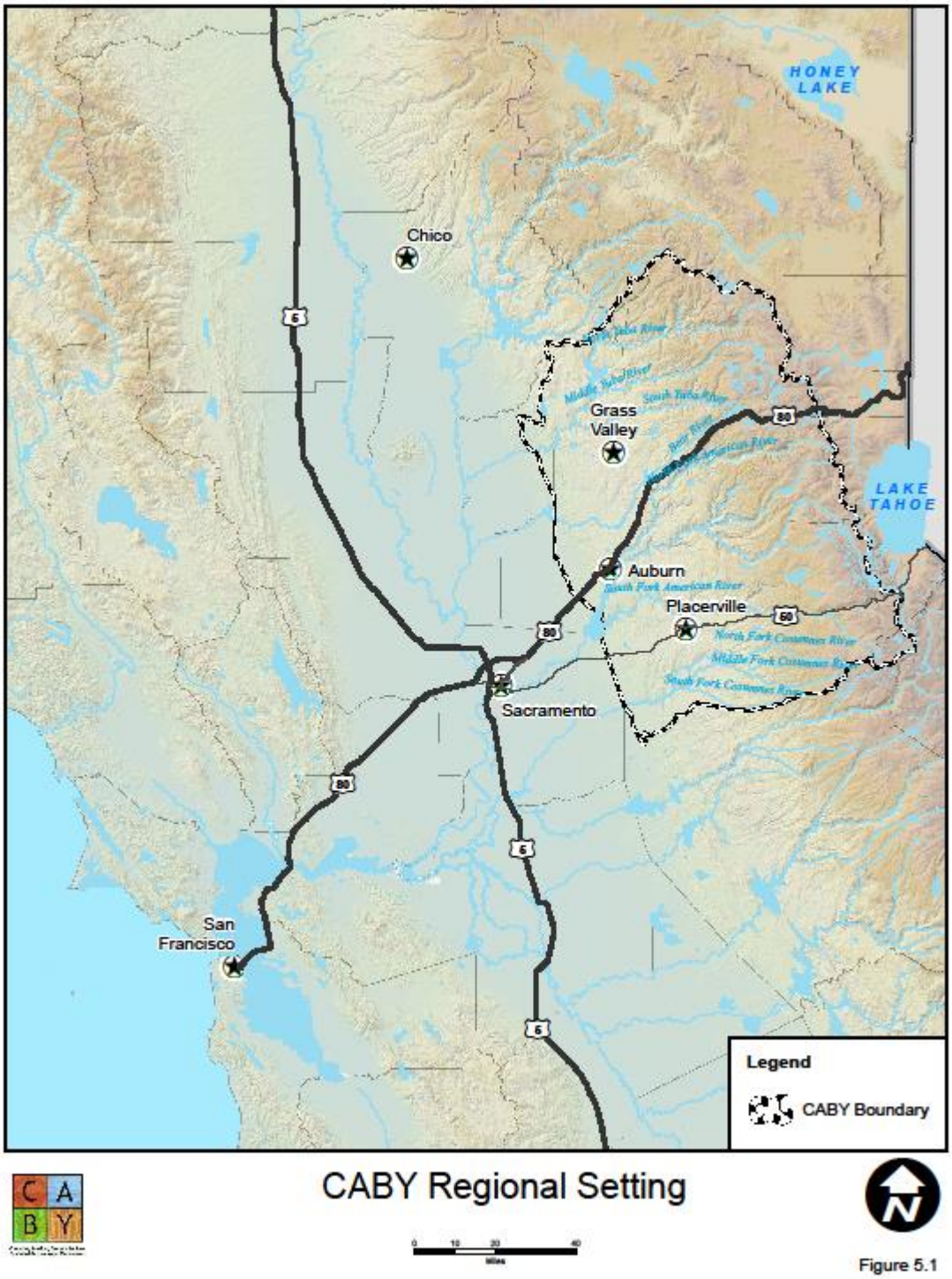

HONEY LAKE
Chico
Grass Valley
LAKE TAHOE
Auburn
Placerville
Sacramento
San Francisco
Legend
CABY Boundary
CABY Regional Setting
Figure 5.1

Figure 5-2

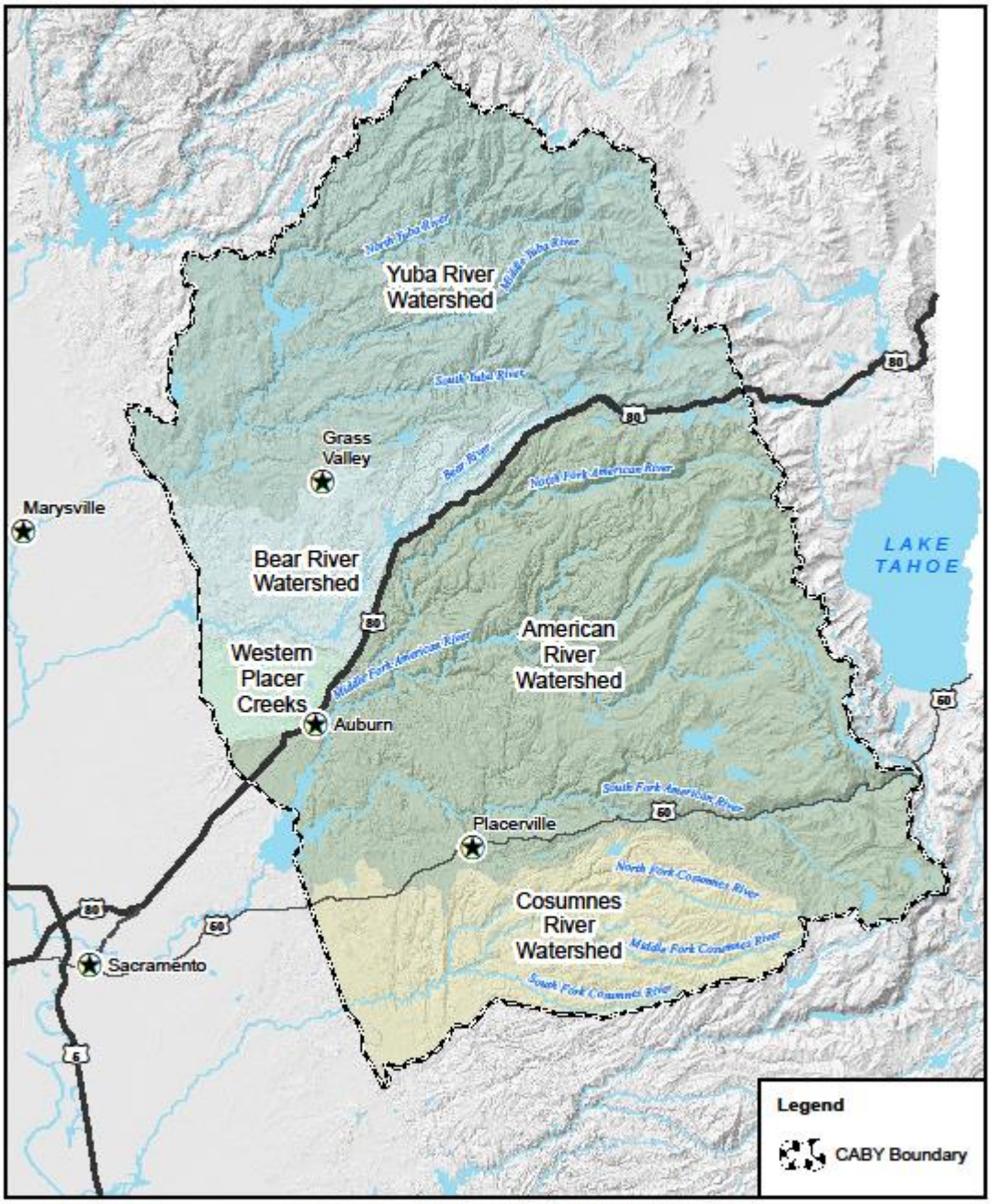


Figure 5.2

5.1.1 Geology and Soils

The landscape is characterized by rugged, steep topography with deeply incised canyons. The Sierra Nevada range is dominated by granitic rock but also includes many types of igneous, sedimentary, and metamorphic rocks. The geologic history consists of hundreds of millions of years of uplift, erosion, volcanism, and glaciation.

The plan area is characterized by crystalline basement bedrock exposed along the central watercourses through the downstream portions of the watersheds. Much of the side slopes and upper headwater portions of the watersheds are composed of various volcanic and superjacent sedimentary materials.

The climate, topography, surface processes, and biota interact to produce the Sierra Nevada soils of the CABY region. The soil properties in this region are varied and strongly influenced by the underlying bedrock.

5.1.2 Precipitation

The climate is characterized by mild, wet winters and hot, dry summers but the variability in climate over the project area is great due to the topographic and elevation ranges. Precipitation generally increases with elevation in the CABY region and average annual precipitation ranges from 22.5 inches in the lowest, most western elevations of the planning region to 85 inches in the highest elevations. Snow levels are generally near 3,500 feet in the winter and rarely reach as low as the valley floor.[2] Average temperatures in the region generally decrease from west to east with elevation; in the summer months, temperatures tend to be warmer in the lower elevations (70°-100°F) and cooler at the higher elevations (60°-80°F). The winter months are mild at the lower elevations (45°-60°F), and cooler at the higher elevations (30°-40°F). Moreover, across the CABY region there are a wide variety of micro-climatic variations based on local topography and air flow which affect local ecosystem characteristics.

In addition to the east-west gradient of precipitation, the northern portion of the CABY region receives proportionally more precipitation than the southern portion. For example, the Cosumnes, the South Fork of the American, and the Middle Fork of the American headwater areas all average 75 inches of precipitation annually. The majority of the Yuba River's upper watershed also receives 75 inches per annum or more. Much of the precipitation in the higher elevations of the CABY region is in the form of snow. Though rain-on-snow events can happen frequently in the spring, this snow melt provides a major source of water for the region and for the state during the dry summer months. Throughout the CABY region, as with most of California, a majority of the rainfall occurs between November and April.[3]

The crest of the Sierra Nevada forms a near impenetrable barrier to storm systems moving in an easterly direction from the Pacific Ocean. This forces the systems to deposit most of their precipitation along the west slope of the range. The plentiful precipitation west of the Sierra Crest provides rivers with enough flow and energy to carve deep V-shaped canyons, evident in the higher elevations of the four watersheds.

[2] NID Urban Water Management Plan 2005
[3] www.cnrfc.noaa.gov/rainfall_data

5.1.3 Hydrology and Groundwater

A groundwater basin is defined as an area underlain by permeable materials capable of furnishing a significant supply of groundwater to wells, or storing a significant amount of water. It includes both the surface extent and all of the subsurface fresh-water-yielding material. These underground reservoirs along with the surface waters comprise the water resources of the CABY region.

Groundwater basins are delineated for some parts of California and subdivided into subbasins to distinguish groundwater systems. Many of these boundaries are not precise and little is known about the hydrogeology and groundwater levels of many of the basins. The CABY planning area occurs primarily in the Sacramento River Hydrologic Region (the Yuba, Bear, and American watersheds); the Cosumnes River watershed portion of the planning area is located in the San Joaquin Hydrologic Region. In 2005, the DWR published the California Water Plan Update, which added the Mountain Counties Area as a Hydrologic Region. The Mountain Counties are portions of the headwater areas of the Sacramento and San Joaquin Rivers, and contain the foothill and mountain areas of these two hydrologic regions. The counties that constitute the CABY planning area are all within the Mountain Counties Area. Thus, much of the information presented below is from the Mountain Counties Area Regional Report in the California Water Plan Update 2009.

5.1.4 Hydrology and Water Resources

The largest of the four watersheds in the CABY region is the American, which comprises 1.2 million acres and roughly 46 percent of the planning area. The Yuba watershed is second largest and includes 900,000 acres and roughly 33 percent of the planning area. Together, these two watersheds alone represent approximately 78 percent of the planning area while the Bear and Cosumnes watersheds comprise the remaining 22 percent (roughly 8 and 14 percent, respectively).

It is the mandated responsibility for all federal agencies to identify potential additions to the National Wild and Scenic Rivers Systems. Agencies assess eligibility through their inventory and planning processes and then manage eligible segments accordingly. The El Dorado National Forest (ENF) and Tahoe National Forest (TNF) recommended Wild and Scenic designations for river segments shown in Table 5-1. Congress will determine whether to designate these recommended rivers to be included in the National Wild and Scenic Rivers System.

Table 5-1
Eligible Rivers for the National Wild and Scenic Rivers System

Watershed	Reach	Eligibility Class	Status	Land Management Agency
	Caples Creek	Wild	Eligible	ENF
	Lower Rubicon River	Scenic/Wild	Recommended	ENF
	Middle Fork American River (below Rubicon River)	Recreation	Suitable	ENF
	Middle Rubicon River	Wild/Recreation	Recommended	ENF
	North Fork Middle Fork American River	Wild/Scenic	Eligible	ENF, TNF
	North Fork of North Fork American River	Wild	Designated	ENF, TNF
	Pyramid Creek	Wild	Eligible	ENF
	Rubicon River	Wild/Scenic	Eligible	ENF
	Silver Fork South Fork American River	Recreation	Eligible	ENF
	South Fork American River	Recreation	Eligible	ENF
	Upper Rubicon River	Scenic	Recommended	ENF
Cosumnes River	Middle Fork Cosumnes River	Recreation	Eligible	ENF
	North Fork Cosumnes River	Recreation	Eligible	ENF
Yuba	Big Granite Creek	Wild		TNF
	Canyon Creek	Scenic	Recommended	TNF, Plumas National Forest
	Lower South Yuba River	Recreation/Scenic	Recommended	TNF
	North Yuba River	Recreation/Scenic	Recommended	TNF

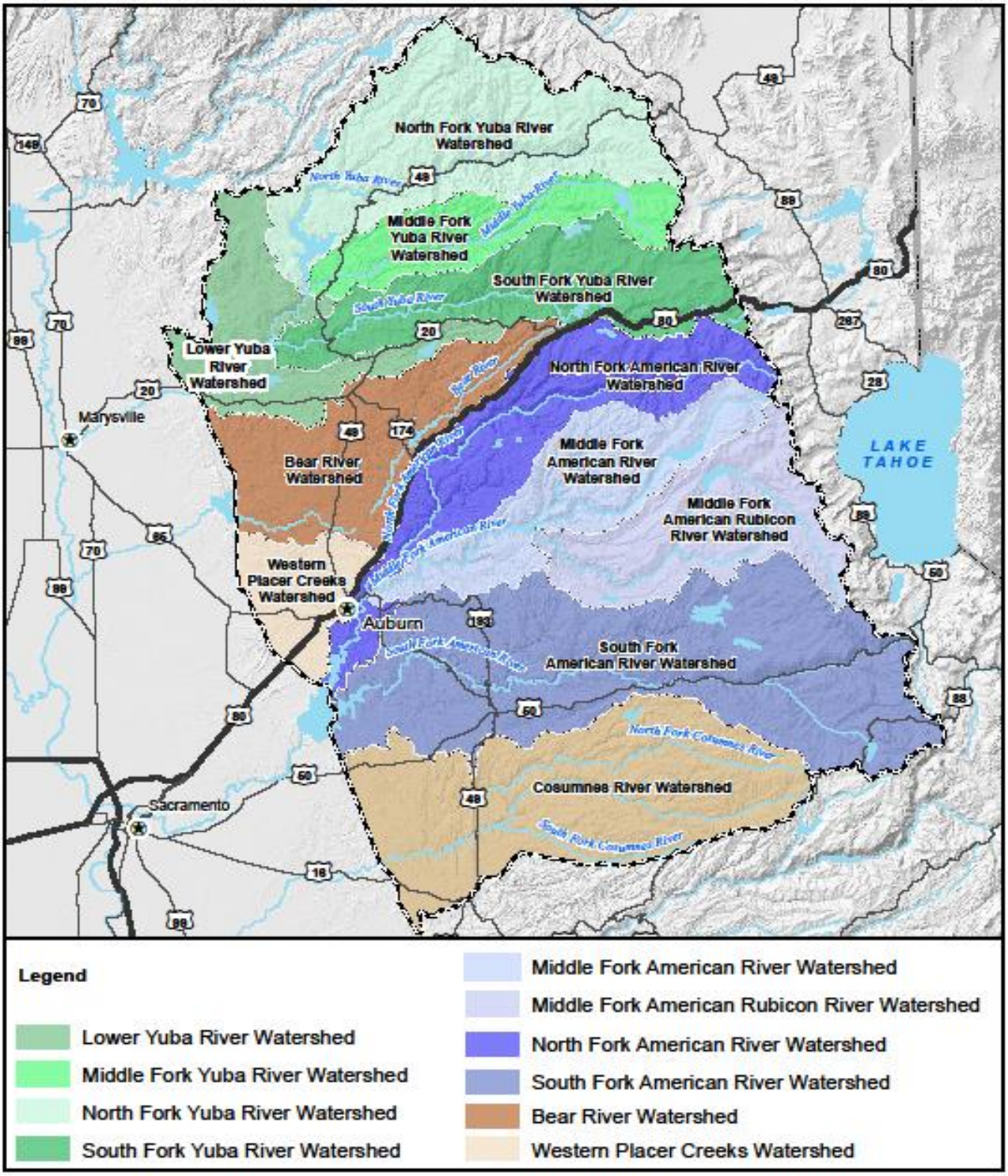
5.1.5 Subwatersheds

Although the State of California recognizes up to nearly 300 subwatersheds within the CABY boundary, for the purposes and scales of this IRWM planning effort, the CABY region is divided into 12 major subwatersheds. Table 5-2, CABY major subwatersheds, lists these subwatershed and the major river drainages. The combined watersheds drain large volumes of water that flow into the Sacramento and Mokelumne Rivers. The Mokelumne River joins the San Joaquin River in the eastern portion of the Central Valley, and the Sacramento and the San Joaquin Rivers form the Sacramento/San Joaquin River Delta. This is an expansive inland river delta consisting of many small, natural and man-made sloughs that create a system of isolated lowland islands and wetlands defined by dikes or levees.

The headwaters of the four rivers originate in the Sierra Nevada and flow west into the Central Valley. There are four main watersheds in the CABY region and 12 subwatersheds (see Table 5-2, and Figure 5-3). Each of the watersheds will be described separately below, highlighting each river's tributaries and hydrologic issues.

Table 5-2 CABY Major Subwatersheds and Land Areas			
Watershed	**CABY Subwatershed**	**Acres**	**% of CABY Region**
Yuba	North Yuba	314,118	11.5
	Middle Yuba	134,992	4.8
	South Yuba	225,895	8.3
	Yuba River	165,063	6.0
	Total Watershed	**840,068**	**30.6**
Bear	**Total Watershed**	**220,168**	**8.1**
American	North Fork American	247,584	9.1
	Middle Fork American	192,273	7.1
	Rubicon	202,051	7.4
	South Fork American	542,230	19.9
	West Placer Creeks	85,443	3.1
	Total Watershed	**1,269,581**	**46.7**
Cosumnes	**Total Watershed**	**390,340**	**14.3**
CABY	**Total Acres**	**2,720,157**	**100.0**
Note that percentages are rounded to the nearest tenth of a percent, and may not always add up to 100%.			

Figure 5-3



CABY Region: Major Sub-Watershed Boundaries

Figure 5.3

1. YUBA RIVER WATERSHED

The Yuba River has three forks (North, Middle, and South Yuba) that converge northwest of Nevada City/Grass Valley. The North Yuba and the Middle Yuba Rivers converge below New Bullards Bar Reservoir and form the main stem of the Yuba River. The Yuba River flows into the north arm of Englebright Reservoir, while the South Yuba feeds the south arm. The Yuba River flows west out of Englebright Reservoir, and eventually out of the CABY region and into the Feather River at Marysville. The Feather River is tributary to the Lower Sacramento River, which eventually flows into the San Joaquin Bay-Delta. The Yuba River watershed, from the crest of the Sierra Nevada to the confluence at the Feather River, near Marysville, is approximately 1,340 square miles; elevations in the watershed range between 9,100 feet to 30 feet above sea level.[4] The portion of the Yuba River watershed within the CABY region is over 900,000 acres, or roughly one-third of the CABY region.

There are over 100 'jurisdictional' dams (impoundments over 25 feet tall and that hold more than 50 acre-feet of water) or diversions in the Yuba watershed. The diversions convey water to local users and to users in the Bear River and the North Fork American River watersheds. A large amount of water is diverted from the watershed at Lake Spaulding on the South Fork for irrigation and power generation.

Fordyce Lake, Lake Wildwood, Jackson Meadows Reservoir, Merle Collins Reservoir, New Bullards Bar Reservoir, Lake Spaulding, and Englebright Reservoir are some of the more prominent water bodies in the watershed.

Englebright Dam marks the division between the Upper and Lower Yuba River. It was completed in 1941 to capture gold-rush era hydraulic mining debris that threatened downstream areas with floods. Englebright Reservoir has a storage capacity of 45,000 acre-feet and provides hydrogeneration and recreational opportunities. Wild chinook salmon spawning habitat exists below Englebright Dam, but lacks fish passage facilities to the Upper Yuba River.[5] Flows on the Lower Yuba River below Englebright Dam are managed to protect chinook salmon and steelhead trout per the Lower Yuba River Accord.[6]

This largely forested watershed has been impacted by historic mining, timber harvest, high road density (compared with other, more rural western forests), dams and diversions, and residential development.[7] The patchwork of landownership in the watershed presents land and watershed management challenges. Several potential or actual impaired water bodies are listed in the Yuba River watershed. The Upper Yuba is also considered a 'priority watershed' for action by the State under the California Unified Watershed Assessment.

Below are descriptions of the four Yuba subwatersheds in: the North, Middle, and South Yuba Rivers, and the main stem Yuba (from the confluence of the North and Middle Yuba Rivers through Englebright and out of the CABY region to the west).

2. NORTH YUBA RIVER SUBWATERSHED

The North Yuba flows for 45 miles from the Yuba Pass area and is the largest subwatershed in the Yuba basin, draining an area of approximately 314,000 acres. Just downstream of its alpine headwaters, it follows along Highway 49, past Downieville, where it is joined by the Downie River. As it continues in a

[4] Upper Yuba River Studies Program Study Team 2003
[5] Upper Yuba River Studies Program Study Team 2003
[6] Lower Yuba River Accord 2007
[7] Shilling

westerly direction, it is joined from the north by three significant tributaries: Goodyears Creek, Canyon Creek, and Slate Creek. The North Yuba River flows into the north arm of New Bullards Bar Reservoir (owned and operated by Yuba County Water Agency), and Willow Creek flows into the south arm of the reservoir. New Bullards Bar dam is PG&E's largest power producer. The North Yuba River contributes nearly 50 percent of the total natural flow of the Yuba River originating above the foothills.[8]

3. MIDDLE YUBA RIVER SUBWATERSHED

The Middle Yuba watershed drains an area of approximately 135,000 acres situated between the larger North and South Yuba Rivers. The Middle Yuba River originates from springs near Meadow Lake in the high Sierra near the crest and initially flows northwest, then west-southwest to its confluence with the North Yuba just south of New Bullards Bar Reservoir. Just downstream from its headwaters, the Middle Yuba River passes through Jackson Meadows Reservoir, the largest impoundment in the subwatershed. Just downstream are Milton Reservoir and the Milton-Bowman Canal, which diverts most of the water from the Middle Yuba River subwatershed to the South Yuba River subwatershed.

Downstream of Milton Reservoir, the Middle Yuba River flows west, just south of Lafayette Ridge. Draining the north slope of Lafayette Ridge and the south slope of Pliocene Ridge, a major tributary to the Middle Yuba, Kanaka Creek enters the Middle Yuba from the north in the lower half of the watershed. Kanaka is a 303(d) listed water body (see Tables 6-1 and 6-2 for complete lists and details on 303(d) water bodies in the CABY region) due to arsenic contamination from historic resource extraction (mining). Other factors, such as low flows and high temperatures on the South and Middle Yuba Rivers, along with the legacy of sediment from hydraulic mining, have contributed to problems for the cold-water-adapted aquatic communities. Downstream of Kanaka Creek, Oregon Creek, the Middle Yuba River's largest tributary, enters the river just upstream of the confluence with the North Yuba, just downstream of New Bullards Bar Reservoir. The Our House Reservoir moves water from the Middle Yuba River to New Bullards Bar Reservoir.

4. SOUTH YUBA RIVER SUBWATERSHED

The South Yuba River originates near Castle Peak/Donner Pass in the high Sierras. The source of the South Yuba River is near the Sugar Bowl Ski Resort in the Mount Disney/Mount Lincoln area. This 225,000-acre subwatershed borders the Middle Yuba River to the north, the main stem of the Yuba to the north, west, and south, and the Bear River and North Fork of the American River to the south. From its headwaters, the river parallels Interstate 80 until it merges with Lake Spaulding, a very important water management impoundment. The Yuba-Bear Project (FERC #2266) and the Drum-Spaulding Project (FERC #2310) originate at Lake Spaulding. Fordyce Creek also feeds Lake Spaulding from the northeast as it drains the high country surrounding Fordyce Lake, another large impoundment in the subwatershed.

Downstream of Lake Spaulding, the river drains west, separated from the Middle Yuba by the San Juan Ridge to the north and a series of small ridges to the south (that separate the South Yuba drainage from the Upper Bear and Deer Creek drainages). Along this stretch, several tributaries, including Fall Creek, Canyon Creek, Scotchman Creek, and Poorman Creek feed the South Yuba River. Near the Malakoff Diggings area (one of the largest placer mining sites in the region), Humbug Creek, a 303(d) listed waterway for sediment, mercury, copper, and zinc, enters the South Yuba.

[8] Upper Yuba River Studies Program Study Team 2003

Thirty-nine miles of the South Yuba River (between Lake Spaulding and Englebright Reservoir) is a designated California Wild and Scenic River and a federally recommended Wild and Scenic River. It is used heavily for recreational purposes. One important recreational access point is the Highway 49 Bridge. A few miles downstream of the bridge the South Yuba flows into the main stem of the Yuba at Englebright Reservoir.

5. YUBA RIVER SUBWATERSHED

The 165,000-acre Yuba River subwatershed spans the width of the Yuba River watershed. The main stem of the Yuba River is formed by the confluence of the North Yuba and the Middle Yuba Rivers just downstream of New Bullards Bar Reservoir. The main stem Yuba and the South Yuba Rivers form the north and east arms of Englebright Reservoir. Englebright Reservoir is a 'debris dam' built by the Army Corps of Engineers in 1941. The USGS has recently characterized the quantity and contamination levels of sediment in Englebright[9] and it is now a Clean Water Act 303(d) listed site (Table 6-1).

Deer Creek enters the Yuba River below Englebright Dam, just below Lake Wildwood. Dry Creek, a major tributary in this subwatershed, begins northwest of New Bullards Bar Reservoir near the CABY boundary, and flows south through Merle Collins Reservoir, and eventually into the Yuba River just west of the CABY boundary.

Deer Creek drains an area of 90 square miles, is a major tributary in the Upper Yuba watershed, and provides water to the Bay-Delta System. The Deer Creek watershed is the most developed in the Yuba basin, as Deer Creek runs directly through Nevada City. Consequently, the Deer Creek watershed has been significantly degraded, and contains three Clean Water Act 303(d) water bodies, listed for mercury or pH. The three water bodies are Scotts Flat Reservoir on Deer Creek, Deer Creek itself, and Little Deer Creek, a tributary to Deer Creek and the main water supply for the City of Nevada City.

Just west of the CABY boundary and 12 miles from the confluence with the Feather River, Daguerre Point Dam serves as a point of diversion to irrigators to the north and south of the Yuba. At roughly 20 feet tall, Daguerre has been identified by federal, State, and local agencies as an impediment to fish passage and, as such, affects the species complement of the entire Upper Yuba.[10]

6. BEAR RIVER WATERSHED

The 75-mile-long Bear River originates at about 5,000 feet elevation roughly 20 miles west of the crest of the Sierra Nevada in northern Placer County, just southwest of Spaulding Lake. Its general course through the CABY planning area is southwest and west to the Feather River. The Bear River forms the boundary between Nevada and Placer Counties for much of its course. The watershed is wedged between two much larger watersheds, the Yuba to the north and the American to the south, and consists of 220,000 acres. Over 990 miles of streams, creeks, and rivers lie within the Bear River watershed. The watershed also contains over 2,000 miles of roads; consequently, approximately 45 percent of the streams in the watershed are within 100 meters of a public road.[11] The Bear River watershed is heavily managed for water conveyance and is considered the region's hydraulic workhorse, conveying water for consumption and energy generation from the Upper Yuba, Upper American, and from its own headwaters and tributaries into the Middle and Lower Bear, Lower American, and the

[9] Upper Yuba River Studies Program Team 2003
[10] Upper Yuba River Studies Program Team 2003
[11] Nevada County Resource Conservation District 2004

associated foothill creek-ravine region.[12] Areas of this watershed have been severely degraded by historic hydraulic mining and mercury contamination. Four waterways within the watershed are listed under the Clean Water Act Section 303(d) for mercury contamination (Lake Combie, Camp Far West Reservoir, Upper Bear River, and Rollins Reservoir – largely because mercury is captured in sediments behind dams), one for bacteria (French Ravine), and one creek (Wolf) is listed for fecal coliform.

The Bear River is fed by the Drum Canal from Spaulding Lake (located on the South Yuba River), which enters the river at the Drum Afterbay, a few miles downstream of the headwaters. The small reach above the Drum Afterbay is termed the Upper Bear River, and is a 303(d) listed reach for mercury contamination (see Chapter 6, Water Quality). The Middle Bear flows out of the Drum Afterbay and enters Dutch Flat Reservoir, where the waters of the Boardman Canal enter after running through Alta Powerhouse, along with the waters from Lake Alta. Dutch Flat also has a powerhouse through which the waters flow before returning to the riverbed. The Bear continues to roughly parallel I-80. Just before Rollins Reservoir, a 303(d) listed water body and the largest impoundment in the upper watershed (774 acres), Steephollow Creek enters the Bear from the north. At this point Steephollow Creek is nearly as long as the Bear itself. Steephollow Creek is separated from the Bear by Lowell Hill Ridge to the south and by Greenhorn Creek by Chalk Bluff Ridge to the north.

Greenhorn Creek, another significant tributary to the Bear, forms the north arm of Rollins Reservoir, while the Bear River forms the northeast arm. Greenhorn Creek is not a 303(d) listed water body; however, a 1999-2001 USGS study found mercury and methylmercury to be pervasive within surface waters and sediments, and present in local invertebrates and frogs in the Greenhorn Creek watershed.[13]

The Bear River discharges from Rollins Reservoir and flows southwest into Lake Combie, located near the community of Meadow Vista and a 303(d) listed water body. Lake of the Pines is a reservoir on Magnolia Creek, located northwest of Lake Combie, and is an area with heavy development pressure. Downstream of Lake Combie, the Bear River turns west and is fed from the north by Magnolia Creek and then Wolf Creek. Wolf Creek and French Ravine are 303(d) listed water bodies for fecal coliform and bacteria, respectively. Wolf Creek flows through Grass Valley, a major urbanized area in the watershed.

Downstream of the confluence with Wolf Creek, the Bear enters Camp Far West Reservoir, bisected by the CABY boundary. The largest water body in the Bear watershed at 1,945 acres, Camp Far West is 303(d) listed due to mercury contamination. The Lower Bear River runs from Camp Far West Reservoir to the confluence with the Feather River, and is outside the CABY region.

7. AMERICAN RIVER WATERSHED

The American River watershed drains almost 2,000 square miles and includes portions of Placer, El Dorado, and Sacramento Counties. The American River originates at the crest of the Sierra Nevada just west of Lake Tahoe, within the Tahoe and El Dorado National Forest boundaries. The American River has three forks: the North, Middle, and South that originate in alpine areas and flow generally west through the Sierra foothills and converge east of Sacramento where the main stem fills Folsom Reservoir. Below Folsom Reservoir, the American River flows southwest through Sacramento and into the Sacramento River.

[12] Yardas and Eberhart 2005
[13] USGS Scientific Investigations Report 2004-5251

Major streams in the watershed include the Rubicon River (and its forks), Duncan Creek, Long Canyon Creek, and Silver Creek. The main reservoirs and lakes in the watershed are Folsom, French Meadows, Hell Hole, Union Valley, Ice House, Lake Valley, Loon Lake, Silver Lake, Slab Creek, and Stumpy Meadows.

Most watershed channels in the region consist of moderately steep gradients and are confined by narrow V-shaped valleys. Riparian vegetation varies by elevation and geology, but generally has considerable cover where undisturbed by human activities and unhindered by bedrock and/or boulders; where present, primary vegetation includes herbaceous species, with middle stories of alder, willow, and cottonwood, depending on elevation.[14] The watershed has been influenced by natural events such as fire, floods, and fluctuating flows, and activities such as mining, grazing, timber management, and recreation.[15] These events and activities are sediment sources for streams in the watershed along with natural mass wasting events (i.e., rockfalls, debris slides, debris torrents, bank erosion).[16] In general, the quality of water in the American River is high from the headwaters to its confluence with the Sacramento River. It is low in alkalinity, mineral content, and organic and microbial contamination.[17]

8. NORTH FORK AMERICAN RIVER SUBWATERSHED

The North Fork American River is 85 miles long and originates in eastern Placer County in the Tahoe National Forest. It flows west and then southwest, passing southeast of the town of Colfax and through Clementine/North Fork Reservoir; it receives the Middle Fork American four miles below the North Fork Reservoir Dam. The North Fork American River drains approximately 387 square miles, making it the American's second largest subwatershed.

9. MIDDLE FORK AMERICAN RIVER SUBWATERSHED

The Middle Fork American River is approximately 65 miles long, flows west-southwest from its headwaters through French Meadows Reservoir and receives the Rubicon River, and then converges with the North Fork American River just northeast of the City of Auburn. The Middle Fork American River drains almost 200,000 acres. Placer County Water Agency (PCWA) owns five hydroelectric plants on the Middle Fork American River (FERC #2079). The research PCWA completed for its FERC relicensing on the Middle Fork contributes greatly to the knowledge base in the region regarding both the Middle Fork, as well as other major waterways in the CABY region.

10. RUBICON RIVER SUBWATERSHED

The Rubicon River subwatershed is located between the Middle Fork American subwatershed to the north, and the South Fork American subwatershed to the south. The Rubicon River is approximately 60 miles long and has a watershed area of almost 184 square miles. The headwaters of the Rubicon River are in the Crystal Range, in the Desolation Wilderness of El Dorado National Forest. The Rubicon River flows through Rubicon Reservoir and Hell Hole Reservoir, and then is joined with the South Fork Rubicon River; it converges with the Middle Fork American River approximately 20 miles northeast of Auburn. The boundary between Placer and El Dorado Counties runs along the Rubicon River for much of its length between Hell Hole Reservoir and the confluence with the Middle Fork American. The Rubicon has been designated as a Wild Trout Stream from its confluence with the Middle Fork American River

[14] Placer County Water Agency 2010c
[15] Placer County 2006-2005 Physical Habitat Characterization Study
[16] Placer County 2006-2005 Physical Habitat Characterization Study
[17] Sacramento Groundwater Authority 2003

upstream to Hell Hole Reservoir. There are relatively few roads into the watershed and the rugged nature of the river valley tends to keep recreational use low.

11. SOUTH FORK AMERICAN RIVER SUBWATERSHED

The South Fork American River (90 miles long) flows west from its origins in the high Sierra in the Eldorado National Forest, receives Silver Creek, a major tributary, and flows past Coloma (the site where Sutter discovered gold in California), where it then turns southwest, receiving Weber Creek before entering Folsom Reservoir. The South Fork American subwatershed is the largest of the American River subwatershed, draining almost 850 square miles. Sacramento Municipal Utility District operates eight hydroelectric powerhouses, El Dorado Irrigation District operates the El Dorado Powerhouse, and PG&E operates one powerhouse on the South Fork American. The stretch between Slab Creek Reservoir and Folsom Reservoir is on the 303(d) list for mercury.

12. WEST PLACER CREEKS SUBWATERSHED

The West Placer Creeks subwatershed is located entirely in western Placer County and encompasses portions of the following towns: Auburn, Bowman, Loomis, and Newcastle. The subwatershed drains the Sierra Nevada foothills from just east of Auburn to the CABY boundary in the west, and encompasses 85,442 acres of the CABY region ranging in elevation from over 2,100 feet near Lake Theodore, to 400 feet at the CABY boundary.

This subwatershed is classified as part of the American River watershed, although the West Placer Creeks do not flow to the American River. Instead, the creeks discharge flows into the East Side Canal in southeastern Sutter County, which then flows into the Cross Canal, and ultimately into the Sacramento River near Verona.[18]

The West Placer Creeks drain in a west-southwest direction, flowing from the higher elevation foothill areas on the east side of the watershed towards the Central Valley. The subwatershed contains the headwaters of Coon Creek, Antelope Creek, Clover Valley Creek, Auburn Ravine, Markham Ravine, and Doty Ravine, a tributary to Coon Creek. Other tributaries to Coon Creek include Dry Creek and Rock Creek.

The West Placer Creeks subwatershed contains several water impoundments, most of which are related to hydroelectric projects (e.g., Wise Forebay, Halsey Forebay, and Halsey Afterbay). The largest water body in the subwatershed is Rock Creek Lake, a reservoir for the Drum-Spaulding Hydroelectric Project.[19] Since these watersheds are relatively small, very little of the streamflow is from natural runoff. Most of the streamflow is water conveyed from the Yuba, Bear, and American River watersheds to meet domestic and agricultural needs in western Placer County and southeastern Sutter County.[20]

Through a collaborative process, the West Placer Creeks have been identified as essential habitat for migrating fish into the Yuba River watershed. Discussions through several CABY Work Groups are taking place as part of the Placer County Water Agency FERC negotiations.

[18] Placer County and Auburn Ravine/Coon Creek Coordinated Resources Management Plan Planning Group 2002
[19] Federal Energy Regulatory Commission 2013
[20] Placer County and Auburn Ravine/Coon Creek Coordinated Resources Management Plan Planning Group 2002

13. COSUMNES RIVER WATERSHED

The Cosumnes River, the most southerly river in the CABY region, flows for over 80 miles (50 miles within CABY) from its headwaters in the Sierra Nevada west to the Mokelumne River, and eventually the San Joaquin Delta. This 390,340-acre watershed has three main forks: the North, Middle, and South. The elevation of the watershed ranges from nearly 8,000 feet in the upper Sierra Nevada to less than 400 feet in the east where the Cosumnes exits the CABY region. The upper reaches of the Cosumnes River are in the Eldorado National Forest, while the lower reaches flow through one of the most biologically rich regions in California's Central Valley consisting of riparian forests, wetlands, vernal pool-dotted grasslands, and blue oak woodlands. The entire Cosumnes River is listed on the EPA's 303(d) list because of contamination by exotic species.

The majority of the watershed is in El Dorado County with a small portion extending into Amador County. The Cosumnes watershed is home to many towns and unincorporated areas, including all or portions of Plymouth, El Dorado Hills, Cameron Park, Pollack Pines, Shingle Springs, and Diamond Springs. All of these communities (excluding Plymouth) are located in the northern portion of the watershed and straddle the boundary between the American and Cosumnes watersheds.

The Cosumnes is billed as the only un-dammed river on the west slope of the Sierra. In theory, this statement is true as the three main forks are free of dams. There are, however, several dams, diversions, and ditches that impound tributaries to the Cosumnes and convey water for agricultural and other purposes. The most significant dam/diversion in the watershed is Sly Park Dam/Jenkinson Lake, originally part of the Central Valley Project, but later transferred to EID's management as part of its irrigation and water storage system. Sly Park Dam/Jenkinson Lake is located in the North Fork Cosumnes watershed and includes Sly Park Dam and Jenkinson Lake on Sly Park Creek, and Camp Creek Diversion Dam on Camp Creek.[21] Jenkinson Lake is the largest reservoir in the Cosumnes watershed, providing 41,000 acre-feet of storage capacity. Additionally, Jenkinson Lake is EID's largest single source of water, providing an average of 23,000 acre-feet per year to the District.[22] Several other dams and diversions exist in the Cosumnes watershed, most of which are privately owned.

14. NORTH FORK COSUMNES SUBWATERSHED

The Cosumnes and its three main forks flow in a west-southwest direction until the river converges with the Mokelumne, outside the CABY boundary.

The 136,103-acre North Fork watershed is the largest of the three and contains some of the larger tributary streams in the watershed including Camp Creek, Clear Creek, Squaw Hollow Creek, and Sly Park Creek. A dam on Sly Park Creek creates Jenkinson Lake, a major reservoir for EID.

15. MIDDLE FORK COSUMNES SUBWATERSHED

The Middle Fork Cosumnes watershed encompasses 85,597 acres and contains a few large tributaries, specifically Dogtown , Sopiago and Spanish Creeks.

[21] Bureau of Reclamation 2006
[22] El Dorado Irrigation District 2005

16. SOUTH FORK COSUMNES SUBWATERSHED

The South Fork Cosumnes is the smallest of the three subwatersheds, encompassing only 43,168 acres. The South Fork originates further west than the other two forks near Cooks Station, California. The primary tributaries of the South Fork Cosumnes are Scott Creek and Cedar Creek. The South Fork and Middle Fork Cosumnes join one mile east of the confluence with the North Fork. The three forks join to form the Cosumnes River that flows west for approximately 13 miles prior to exiting the CABY region. The 13-mile stretch of the Cosumnes River within CABY accounts for the remaining 125,472 acres of the Cosumnes River watershed.

5.1.6 Vegetation Communities

The Sierra Nevada encompasses 88 plant community types as defined by California's Natural Heritage Division. Sierra mixed conifer forest and blue oak woodland are the most extensive types, covering 2,300 and 2,100 square miles, respectively. Sixty-seven plant community types have a mapped distribution greater than 10 square miles. Widespread types exhibit considerable floristic variation from the northern to southern ends of the range and are best analyzed on a subregional basis. Of California's 7,000 vascular plant species, about 50 percent occur in the Sierra Nevada. Of these, more than 400 species are found only in the Sierra Nevada, and 200 of those are considered rare.[23]

The CABY region supports a wide variety of vegetation communities, as the planning region encompasses a broad spectrum of environmental conditions, such as elevation, slope, aspect, soils, and precipitation. Using the CALVEG[24] classification system developed by the California Department of Forestry and Fire Protection (CDF), 49 distinct vegetation/land cover community types were identified in the CABY region boundaries. Roughly one quarter of the planning area (26%) is covered by the Sierra Mixed Conifer series, which includes ponderosa pine (*Pinus ponderosa*), Douglas-fir (*Pseudotsuga menziesii*), and incense cedar (*Calocedrus decurrens*), among others. The Westside Ponderosa Pine Forest, characterized by an open coniferous canopy, is dominated by its namesake ponderosa pine. It has a typically sparse understory of shrubs and young trees and covers approximately 16 percent of the CABY region. The Foothill Pine-Oak Woodland, dominated by foothill pine (*Pinus sabiniana*) and blue oak (*Quercus douglasii*) covers about 10 percent of the planning area. The Sierra Mixed Conifer, Westside Ponderosa Pine Forest, and Foothill Pine-Oak Woodland cover types occupy over half of the CABY region's 2.8 million acres.

A complete list of vegetation communities and their acreages and percent cover in the CABY region are listed in Appendix D, Table D-3. The vegetation communities include several different oak woodlands, mixed pine and other conifer communities, several different chaparral communities, and a few scrub vegetation types. The most common heavily modified landscapes include non-native grasslands (2.6%), agricultural land (2.0%), mid-elevation conifer plantations (1.2%), and urban or developed land (1.0%). Most of these cover types are in the western part of the region where elevation, soil type, slope, and access facilitate anthropogenic disturbance.

Impacts to plant populations have come largely from settlement, grazing, and fire suppression. The plant species of special concern, along with habitats and species of concern of other life forms (amphibians, birds, invertebrates, reptiles, and mammals), are presented below. While riparian plant communities

[23] Sierra Nevada Ecosystem Project 1996
[24] California Gap Analysis 1998. And:
http://www.fs.fed.us/r5/rsl/publications/rsmapping/ca-landcovercooperative.pdf#search=%22CALVEG%20CDF%22

often contain a high percentage of the most rare and unique plant species, out of several habitat types with these qualities – the foothill woodland and chaparral communities – have been particularly damaged and fragmented by changes in agriculture and settlement. Invasion of non-native plant species has been most pronounced in the foothill areas and is associated with livestock grazing and settlement patterns.[25]

Catastrophic Wildfire: Historically, fire played an important role in maintaining diverse landscapes in the CABY region. Accumulated fuels resulting from fire suppression and land management practices have increased the fuel loads and risk of catastrophic fire in many parts of the region.

5.1.6.1 Invasive Species

Terrestrial plant communities are threatened by the establishment and spread of non-native, invasive species. Species such as yellow star thistle, spotted knapweed, invasive brooms (Scotch, Spanish, and French), and Himalayan blackberry are pervasive in most of the lower elevation watersheds, especially in the Cosumnes and American watersheds.

Aquatic invasive species invasions, from species such as quagga mussels and other exotics, is anticipated without extreme vigilance from aquatic managers and the public. Threats from aquatic invasives are particularly insidious because of the interconnections between streams systems, and thus the ability for invasives to spread quickly.

5.1.7 Biological Resources – Species and Habitats of Special Concern

About 300 terrestrial vertebrate species (including mammals, birds, reptiles, and amphibians) use the Sierra Nevada as a significant part of their range, and more than 100 others use the Sierra Nevada as a minor part of their range. In total, about 60 percent of the state's vertebrate fauna occur in the Sierra Nevada to some extent. Thirteen species are restricted (endemic) to the Sierra Nevada region; the CABY region supports many of these.

The region contains a number of sensitive, threatened, and endangered species. Information regarding species and habitats of special concern within the planning area is supplied by the California Department of Fish and Wildlife. The California Natural Diversity Database (CNDDB) records documented occurrences of 121 species and nine habitats of special concern within the CABY planning boundary.[26] Appendix D, Table D-1 lists the number of species of concern for each life form and the number of habitats of concern in the CABY region. A complete list of these species and habitats, including their common and scientific names (for species only), State and federal status, and the number of documented occurrences within the CABY region is also provided in Appendix D, Table D-2.

Species of Special Concern: Fifty-four species of terrestrial vertebrates (18% of the Sierra fauna) are considered at-risk by State or federal agencies, listed as endangered, threatened, special concern, or sensitive. The most important identified cause of the decline of Sierra vertebrates is the loss of habitat, especially foothill and riparian habitats and late successional forests. In the Sierra, 82 terrestrial vertebrate species are considered dependent upon riparian (including wet meadow or lakeshore) habitat; 20 of these are considered at-risk. Eighteen species are dependent upon late successional forests; five of these are at-risk. Although few Sierra species appear to require closed forest canopies,

[25] Sierra Nevada Ecosystem Project 1996
[26] California Department of Fish and Game 2012

many more depend upon the presence of large old trees, snags, and downed logs in all Sierra woodland and forest communities for some part of their life cycle.[27]

The Foothill Yellow-Legged Frog is one of the best-known endangered species in the CABY region. The PCWA FERC relicensing process has helped shed light on the frog's needs for survival and reproduction. As new empirical data becomes available through project monitoring activities, expert judgment may indicate that alternate management strategies are required.[28]

Habitats of Special Concern: The habitats of special concern include four types of fish-bearing streams, three types of wetlands (a seep, a fen, and a bog), a chaparral habitat in the lowlands, and a montane forest habitat. The important habitats within the CABY region are not limited to those listed in the CNDDB. Eighty-five terrestrial vertebrate species require west-slope foothill savanna, woodland, chaparral, or riparian habitats to retain population viability; 14 percent of these are considered at-risk. The number of species actually declining in the foothill zone of the Sierra Nevada is undoubtedly far greater because so much critical habitat has been converted to urban and residential use. Many of these species do not rate State or federal listing because their distributions include habitat in other parts of the state.[i]

As described below, efforts are underway to protect important habitats in the region.

- *Western Placer Creeks*

The Western Placer Creeks (WPC) are a series of creeks that begin in the Sierra Nevada foothills in western Placer County and flow west into Sutter and Sacramento Counties, ultimately making their way into the Sacramento and American Rivers just north of the Sacramento-San Joaquin Delta. Much recent attention has been given to the need to restore the Delta for the recovery of salmon and steelhead in California. However, simply restoring the Delta is only one component of addressing the life cycles of these important fish species. Once fish pass through the Delta, viable habitat is needed for successful spawning and rearing. With their positive regional characteristics and collaborative stakeholders, the Western Placer Creeks are an ideal region to help address California's declining native fishery populations in a cost-effective manner, and it constitutes a high-priority restoration area for the CABY region.

Many of the stakeholders in the WPC Work Group have participated extensively in PCWA and Nevada Irrigation District permitting and FERC processes, in some cases using perspectives and information developed in the committee to inform the FERC process, and in some cases using FERC work to inform WPC work. The primary outcomes of the Work Group process are: 1) the recommendation that a baseline assessment be prepared, using information developed during the FERC process as well as location-specific data collection and evaluation; and, 2) the desire to develop an integrated suite of projects based on defensible science that would materially increase the habitat values and therefore the fish populations in the region. It is the hope of CABY stakeholders that these activities will reprioritize WPC in federal agencies' restoration concerns as a viable alternative or option to introducing fish above the dams. Participants are actively lobbying that the WPC area be a design option inside the larger picture of fish restoration negotiations throughout the larger region.

[27] Sierra Nevada Ecosystem Project 1996
[28] Placer County Water Agency 2010

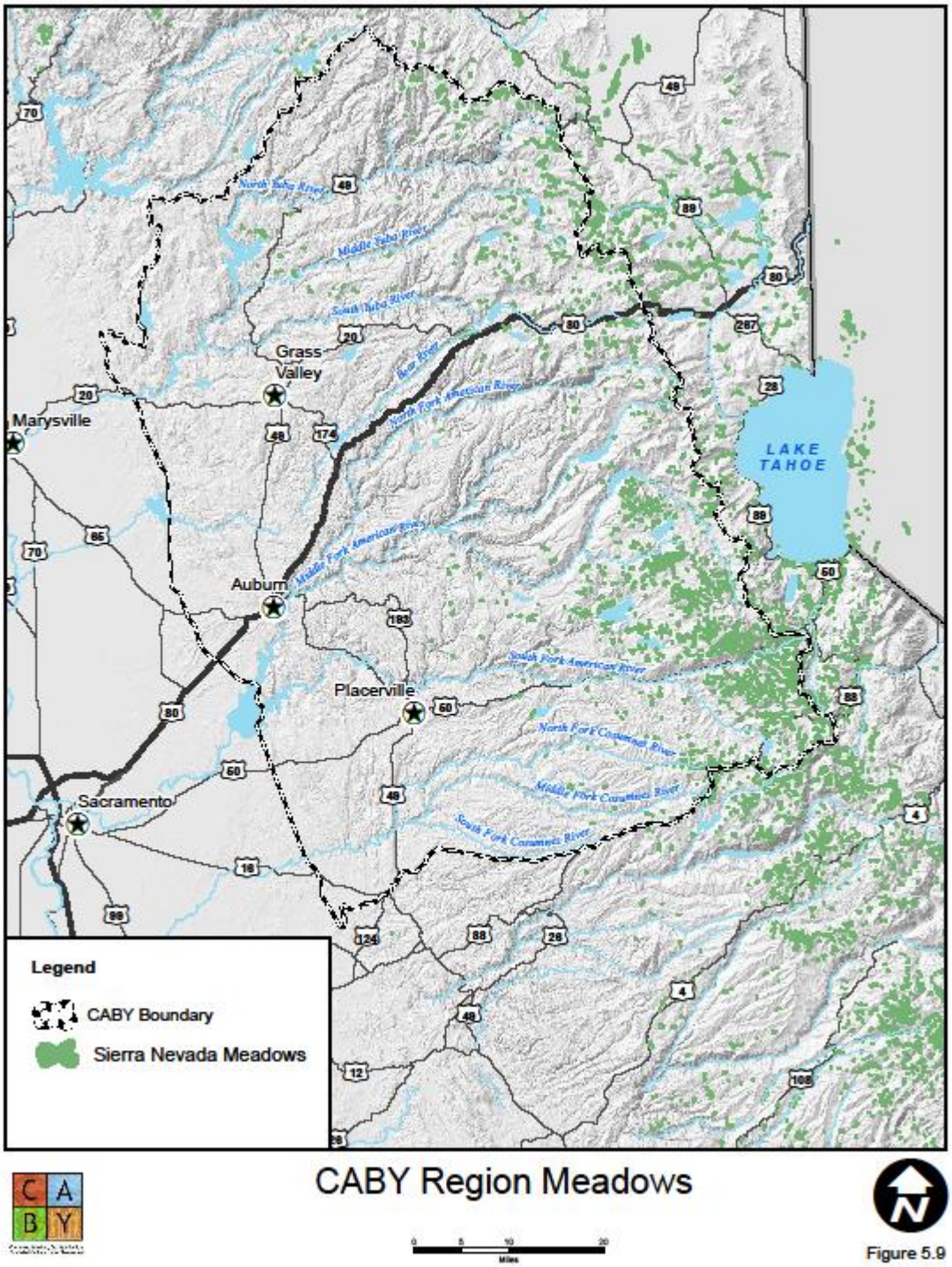
- *Mountain Meadows and American Rivers' Research*

Sierra Nevada meadows are iconic California features, highly valued for their plant and wildlife diversity, forage for livestock, water conservation, cultural heritage, and recreational uses. Some describe montane meadows as 'keystone' to mountain ecosystems and watersheds. Formed by glacial processes, these areas occur where sediment and water converge from the surrounding drainage area, making them places of high moisture availability in what can be an otherwise water-limited landscape.

While meadows cover only a small fraction of the overall land area in the CABY region, their condition is critical to that of the broader region and to the economic vitality of those who rely upon them for livestock forage. The natural productivity of meadows prompted settlers and other groups to put them to use, sometimes intensively. Over time, many of these meadows have become degraded, either historically or more recently, impacting humans and the wildlife that depend on them. As knowledge grows of the natural and economic benefits well-managed Sierra meadows can provide, there has been a surge of interest among ranchers, conservation groups, and others in the CABY region to invest in the revitalization of these dynamic natural systems.

Historical Impacts on Sierra Meadows: Mountain meadows have been impacted by human activity for centuries. Historically, impacts on mountain meadows include mining, road building associated with timber extraction, livestock grazing, fire suppression, and water diversions. Land uses that have affected the health and status of mountain meadows began with domestic livestock grazing by the Spaniards in the 17th century. The discovery of gold in the mid-19th century increased the exploitation of mountain meadow resources in the CABY region to support mining activities. In the 20th century, as the state's population grew, the need for agricultural and municipal water in California's Central Valley and coastal areas drove the construction of elaborate and extensive water transport and delivery systems and hydroelectric power facilities throughout the water-rich western slope of the Sierra Nevada. Many of these diversions and irrigation ditches were developed to support historic mining and transitioned to water-delivery use. Diversion and irrigation ditches formed a vast network that altered local and regional stream hydrology. Waves of timber harvesting and associated road construction further intensified erosion and sediment delivery in rivers and meadow streams. While brought to the region by the global travel of humans, invasive non-native plant and animal species proliferated in the wake of road construction and other soil disturbances. Changes in fire frequency, cycles of wetter and drier weather conditions, and reduced water-holding capacity within meadows due to downcutting of streams, have facilitated conifer encroachment in some mountain meadows.

Figure 5-4


Grass Valley
Marysville
Auburn
Placerville
Sacramento
LAKE TAHOE
North Yuba River
Middle Yuba River
South Yuba River
Bear River
North Fork American River
Middle Fork American River
South Fork American River
North Fork Cosumnes River
Middle Fork Cosumnes River
South Fork Cosumnes River
Legend
CABY Boundary
Sierra Nevada Meadows
CABY Region Meadows
Miles
Figure 5.9

The Benefits of Healthy Mountain Meadows: Many environmental and habitat values are attributed to mountain meadows. Several threatened, endangered, and rare plants are found only in Sierra wet meadows; and vulnerable, threatened, and endangered animal species rely upon mountain meadows for all or part of their habitat needs. Healthy mountain meadows store water and help to provide clean water. When streams overtop their banks in meadow ecosystems, the water flows across adjacent areas. The flow of water is slowed by the vegetation, allowing it to percolate into the ground. The natural capacity of a meadow to absorb floodwaters and recharge water held in subsurface soil and rocks (groundwater) allows for storing and releasing of groundwater over a long period of time. In this way, meadows help lower in-stream water temperatures and may increase dry-season flows downstream. This cool, late-summer water supply can be critical for many species of native fish and other aquatic life. Healthy meadows also help to control erosion of soil and resulting sedimentation of streams. Excessive sedimentation within streams cause problems for aquatic life, reduces the quality of drinking water, and increases the costs of water treatment. Healthy mountain meadows act as natural filters, helping to reduce erosive action of floodwaters and the amount of sediment transported downstream, thus protecting water quality.

Mountain meadows also include important cultural sites. They have been an essential part of Native American cultures for millennia. Plants unique to these meadows provided abundant materials to indigenous cultures for medicine, food, and basket weaving. Significant prehistoric archaeological sites are located in mountain meadows, indicating their importance to the native peoples of the Sierra.

Mountain meadows continue to be important sites for livestock grazing. The Sierra Nevada currently supports several hundred square miles of public and private meadows used as rangeland. Nearly half of these meadows are privately owned and many have been stewarded by ranching families for generations. Healthy mountain meadows, both privately and publicly owned, offer reliable forage for local ranches and support healthy ecosystems. Healthy mountain meadows provide increased forage compared to degraded systems. In addition, privately owned meadows provide green space (compared to developed space) that many enjoy.

Contemporary Threats: Current and projected population growth, loss of green space to development, and climate change are some of the biggest threats to the ecosystem services provided by mountain meadows. These areas currently experience increased recreational visits. Some meadows continue to be intensively grazed by livestock. Privately owned ranches continue to be sold to developers. Climate change has altered the timing and amount of water that supports these ecosystems. Impacts from some historic disturbances continue to degrade the ecosystems where they occurred and will not heal without restoration efforts.

Over the last 10 years, there have been a series of meadow restoration demonstration projects in the Sierra resulting in initial quantifiable results indicating that large-scale meadow restoration in the Sierra will likely provide multiple benefits including water supply, water quality, and habitat.

5.1.8 Fisheries

The major rivers and streams in the region once supported native fish (splittail, chinook salmon, coho salmon, steelhead trout, lamprey, white sturgeon) and currently support a recreational fishery (rainbow

trout, brown trout, mackinaw trout, red bass). Anadromous fish are nearly extinct from Sierra rivers due to dams, impoundments, and degraded stream conditions.[29]

The river systems, wetlands, lakes, reservoirs, ponds, and small alpine streams in the planning area provide a variety of aquatic habitats that support a varied fishery. Native and non-native species are present in most waterways of the CABY region. Historically, the main streams in the region supported runs of wild chinook salmon (*Oncorhynchus tshawytscha*) and steelhead trout (*Oncorhynchus mykiss*), which had access to many miles of prime spawning habitat in the upper watersheds. In the CABY region, the last remaining runs of these anadromous fish can be found on the Lower Yuba River (below Englebright Dam) and the Cosumnes River, which supports a population of fall-run chinook.[30] In the 1990s, chinook salmon and steelhead in the Sacramento River and its tributaries were listed under the federal Endangered Species Act. Winter-run chinook is listed as endangered and spring-run chinook and steelhead are listed as threatened.

Dams and impoundments, which block fish access to streams and alter stream flow patterns and temperatures, together with degraded conditions above dams, have led to a huge loss in the historic habitat of anadromous fish.[31] For example, on the North Fork of the Yuba River, chinook salmon and steelhead used to access waterways as far east as Sierra City. Englebright Dam, very close to CABY's western boundary near the valley floor, halted that migration in 1941, cutting off many dozens of miles of habitat and resources to this now-endangered species.[32] However, the reservoirs also have been shown to provide more consistently cool temperatures throughout the season, to the benefit of many cold-water species.[33] Also, some studies show reservoirs as having good habitat for some types of fish, including some native fish.[34]

Other native fish species found in the watersheds include:

- California roach *(Lavinia symmetricus)*
- Hardhead *(Mylopharodon conocephalus)*
- Pacific lamprey (*Lampetra tridentate)*
- Sacramento pikeminnow *(Ptychocheilus grandis)*
- Sacramento sucker (*Catostomus occidentalis)*
- Splittail (*Pogonichthys macrolepidotus-listed as federal threatened*)
- White sturgeon (*Acipenser transmontanus)*

Additionally, native fish are being out-competed by non-natives such as red eye bass, sunfish, and brown trout. Non-native fish species found in the watersheds include:

- Green sunfish *(Lepomis cyanellus)*
- Brown trout *(Salmo trutta)*
- Smallmouth bass *(Micropterus dolomieu)*
- Brown bullhead *(Ameiurus nebulosus)*
- Kokanee salmon *(Oncorhynchus nerka)*
- Carp *(Cyprinus carpio)*
- Red eye bass *(Micropterus coosae)*

[29] SNEP 1996
[30] Yoshiyama, et al. 2001
[31] Sierra Nevada Ecosystem Project 1996
[32] op.cit Yoshiyama, et al.
[33] The PCWA FERC relicensing work included an examination of temperature fluctuations on the Middle Fork of the American River, including the Rubicon. This information may be viewed in the maps section of PCWA 2010b.
[34] PCWA 2011b

Another consideration for healthy fisheries is the system bioenergetics, or the circulation of energy in the system. This can be measured, in part, by the availability of food for fish, of which macro-invertebrates play a large role. The PCWA relicensing process generated data on macroinvertebrate drift, and found that a consistent pattern in the drift density was not present in the data, but that generally the study region (North and Middle Forks of the American River) showed less than 20 percent drift density compared to highly productive trout streams. Predictably, along with the lower density, the size trend of the macroinvertebrates was generally small, with few larger than five millimeters. These results are similar to those found in other studies. Increasing food availability (by 10% and 20%) increased fish growth at all study sites.[35]

The fisheries of the CABY watersheds are managed by the California Department of Fish and Wildlife. Particular reservoirs and streams are stocked with game fish for recreational purposes. Many of the reservoirs in the region provide excellent fishing opportunities.[36]

5.1.9 Likely Climate Change Impacts

Climate models project that this region will warm by 2° to 4°F in the winter and 4° to 8°F in the summer by the end of the century.[37] Precipitation is less predictable, especially within the region's microclimates, but the increase in temperature is projected to bring about a higher level of evapotranspiration, and thus less available moisture overall, even in areas that experience increased precipitation.

Across the Sierra, snowmelt occurs three to six weeks earlier than it did 60 years ago. With rising temperatures, more precipitation now falls as rain than snow. This has serious implications for a region whose snowpack has historically served as a 'reservoir,' a reliable slow-melting source of water for the rest of California. As snow melts sooner and faster and combines with precipitation increasingly falling as rain rather snow, uncertainty in water storage and release will confront water managers and hydropower producers. Flooding impacts increase with storm intensity and higher winter precipitation events, while summer streamflows are expected to diminish over the season, compromising domestic and environmental water supply and quality, and engendering tough choices for water managers and policy makers.

Projected climate impacts for this region include:

- reduced streamflow and water supply in the long term that will generate hard choices for water managers, and potentially increased conflicts between human and environmental uses;
- reduced water quality from the direct effects if rising temperatures to the indirect effects of eutrophication, increased algal growth, release of mercury methylation, increased sedimentation from increased winter runoff, and decreased vegetative cover due to fire;
- increased wildfire potential and, in particular, catastrophic wildfire with consequences for forest function, ecosystem health, and social and economic costs;
- upslope movement of vegetative communities as temperatures rise;

[35] PCWA 2011
[36] CDF&W website
[37] Safford, H.D., M. North and M.D. Meyer. *Chapter 3: Climate Change and the Relevance of Historical Forest Conditions*, *Managing Sierra Nevada Forests.* Albany, CA: U.S. Department of Agriculture, Forest Service, Pacific Southwest Research Stations. **Date?** Available from: http://www.fs.fed.us/psw/publications/documents/psw_gtr237/psw_gtr237_023.pdf

- potential fragmentation and/or degradation of habitat for stream-dependent species and elevationally dependent species in particular – species that are confined in their ability to move or re-adapt;
- greater colonization and numbers of both terrestrial and aquatic invasive species;
- increased flooding with greater storm intensity and higher winter precipitation;
- inability of water infrastructure designed for an historic flow regime to accommodate increased winter peak flows;
- reduced viability for heat-sensitive crops – berries, mandarin oranges, grapes, and apples – and a potential reduction in agro-tourism, although alternative crops may begin to be viable here; and,
- effects on the region's recreation industry from lower summer flows, both rafting and reservoir-based use.

CABY water agencies are among the savviest in the state, having incorporated climate modeling into their respective management projections for some years now, and responding to those projections with adaptive conservation and operational strategies. Federal, State, and local agencies and NGOs have responded as well, with innovative responses to create climate resiliency on the ground — forest management strategies that account for the upslope movement of species, restoration of mountain meadows to enhance the slow releases from the region's watershed, and use of alternative energy production. Table 11-2 displays the region's vulnerabilities and suggested adaptive strategies, developed by CABY's climate Technical Advisory Committee.

5.2 CABY Region Boundaries, Overlapping IRWM Regions, and Land Uses

This section describes the CABY internal IRWM boundaries and basic land uses of the region. The municipalities, service areas of individual water, wastewater, flood control districts, and land use agencies are described further in Chapter 8 Water and Land Use Coordination.

5.2.1 Rationale for the CABY Regional and Internal Boundaries

The CABY region consists of 2,786,285 acres and encompasses all or part of nine counties. Four counties make up the largest portion (77%) of the CABY planning area: El Dorado (36%), Placer (23%), Nevada (18%). Five remaining counties include smaller portions of the CABY region: Sierra, Yuba, Plumas, Amador, and Alpine. The CABY upper watershed planning region was defined by the resource issues unique to the Sierra Nevada; the water supply infrastructure connectivity between watersheds on the western slope; and the willingness of water suppliers, power producers, watershed groups, and NGOs to work together to develop a regional water management plan.

From a watershed perspective, CABY's northern, eastern, and southern boundaries are coterminous with the watershed boundaries of the Cosumnes, American, and Yuba Rivers. These rivers are included in the planning area from their source in the high Sierra to the point at which they exit the foothill region and enter the flat valley region. The western boundary follows the 400-foot elevation line, creating a purposeful delineation between upper and lower watersheds.

The CABY IRWMP region borders were based on the similarities in the physiography of the watersheds, socioeconomics, hydrology, geology, hydrogeology, water storage and delivery infrastructure, and land use. The area also has similar or closely related policy issues and management entities. In addition, water purveyors within the CABY region are tied together by water delivery infrastructure. Through

pipes, canals, reservoirs, lakes, and pumps, water from NID in the northernmost watershed of the planning area can be delivered to EID in the south. This makes CABY a man-made 'watershed' in and of itself. Operational policies and decisions by each water agency, along with stakeholder interests, affect the entire CABY region.

Three of CABY's water agencies (EID, NID, and PCWA) draw on at least two of the rivers each for supply, sharing that surface water supply with the neighboring water agency. The fourth CABY water management agency, El Dorado County Water Agency (EDCWA), does not draw water, but manages the water resources of El Dorado County. Extensive infrastructure exists to divert water between watersheds within the CABY region.

The rationale behind the establishment of boundaries for the CABY region is directly related to the physical rather than political attributes of the area. It is important to note that the CABY region is discrete for specific reasons: the upper watershed environments and resource management issues are distinct from those in the lower reaches; there are a number of sensitive, threatened, and endangered species that are unique to the area; upper elevation groundwater systems differ vastly from lower elevation and valley floor systems; CABY's stakeholder community is quite different from that of the valley floor's; and issues of source-area water resources are unique to CABY given our region's inclusion of the headwaters of the four rivers.

5.2.2 Overlap with Other IRWM Regions

As discussed in Chapter 3, Coordination, the CABY IRWM region contains minor overlap with three adjacent IRWM regions: the Mokelumne-Amador-Calaveras IRWM to the south, the American River Basin IRWM to the west, and the Yuba Region IRWM to the northwest. These are strategic overlaps, and an approach for coordination has been negotiated with the overlapping regions: a two-part strategy including the development of a Memorandum of Understanding for ongoing collaboration in 2010, and a project development process to be applied in each overlapping region. If either IRWM region proposes a project in an area of overlap, that region presents the project details to the other IRWM region.

CABY does not receive water supplied from the Sacramento-San Joaquin Delta. The CABY region supplies and provides flood control benefits to the Sacramento-San Joaquin Delta.

5.2.3 Land Uses

Main population centers in the CABY region are Alta Sierra, Auburn, Nevada City, Colfax, Foresthill, Grass Valley, Loomis, Meadow Vista, North Auburn, Placerville, Plymouth, Pollock Pines, Shingle Springs, El Dorado Hills, and Cameron Park. These population centers are confined primarily to the western part of the project area in the lower elevations (see Figures 5-1 and 5-2).

Historically, the economies of the mountain and foothill communities of the Sierra Nevada have been tied to the land. Over the last few decades, the CABY region has experienced a shift in land use away from traditional rural land uses such as timber harvesting, livestock grazing, and irrigated agriculture, and toward rural residential developments.

This trend has largely been driven by an influx of new residents into this area in the early 1970s.[38] CABY's population is expected to grow at a rapid rate. California Department of Finance projects a

[38] Wacker et al. 2002

population increase in the Mountain Counties, in which all CABY counties are located, of 85 percent between 2000 and 2050. This would be an increase of 373,732 people in the CABY region alone between 2000 and 2050.[39]

Private lands constitute 56 percent of the CABY region. Private ownership in the western part of the CABY region consists mostly of residential and/or agricultural holdings, while in the upper watersheds timber companies own a large percentage of the private lands, managed for commercial timber production. About 50 percent of the Yuba River watershed is owned by private individuals or corporations. In the Bear River watershed, 87 percent is privately owned, making most stretches of the Bear River inaccessible to the public. Private entities control approximately 60 percent of the American River watershed and about 70 percent of the Cosumnes River watershed.

About 43 percent of the region is owned and managed by federal agencies (primarily Tahoe and El Dorado National Forests and, to a lesser extent, Plumas National Forest, the Bureau of Land Management, Bureau of Reclamation, U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service, and Bureau of Indian Affairs. Most of the higher-elevation lands are under management by the Forest Service (Table 5-3). Public lands are often in a one-square-mile 'checkerboard' ownership, a remnant of historic railroad development. Present-day impacts of such patterns present challenges to land managers, including timber producers, wildlife managers, and the national forests.

Table 5-3
Ownership by Government Class and Name in CABY Region

Owner	Name	Acres	Percent of Region
Federal	Army Corps of Engineers	1,596	0.1
Federal	Bureau of Indian Affairs	148	<0.01
Federal	Bureau of Land Management	66,446	2.4
Federal	Bureau of Reclamation	24,538	0.9
Federal	Forest Service	1,117,281	40.1
Federal	Military (USAF)	71	<0.01
Private	Various	1,550,257	55.6
State	Dept. of Fish and Game	21,238	0.8
State	Parks and Recreation	4,708	0.2
Total		**2,786,283**	**100.0**

A variety of land uses occur in the CABY region. Most are associated with natural resource uses (see Table 5-4, below). Agricultural land use is generally confined to lower elevations.

[39] DWR 2009

Table 5-4
Land Cover of the CABY Region

Land Cover	Acres	Percent of Region
Agricultural Land	54,798	2
Bare Exposed Rock	48,224	2
Black Oak Woodland	170,975	6
Blue Oak Woodland	39,777	1
Canyon Live Oak Forest	49,590	2
Chamise Chaparral	30,229	1
Foothill Pine-Oak Woodland	269,648	10
Huckleberry Oak Chaparral	14,818	1
Interior Live Oak Forest	70,783	3
Interior Live Oak Woodland	44,257	2
Jeffrey Pine-Fir Forest	102,602	4
Lodgepole Pine Forest	39,402	1
Mid-elevation Conifer Plantation	32,494	1
Mixed Montane Chaparral	107,142	4
Non-Native Grassland	71,441	3
Permanently-flooded Lacustrine Habitat	25,295	1
Red Fir (Lodgepole Pine)-Western White Pine Forest	50,841	2
Red Fir Forest	173,229	6
Sierran Mixed Coniferous Forest	740,867	27
Sierran White Fir Forest	29,707	1
Urban or Built-up Land	26,487	1
Valley Oak Woodland	13,931	1
Westside Ponderosa Pine Forest	450,005	17

* LCMMP mapping used to develop regional estimates of land cover

The amount of land devoted to agriculture (including grazing land) and forestry has decreased significantly from 1957 to 2001 giving way to residential land uses. For example, in Nevada County agricultural land use decreased from 33 percent to 10 percent between 1957 and 2001, while private land under rural residential and recreational use had increased from 30 percent to 70 percent, between this same time frame. Mining and other commercial uses dropped to two percent and timber land uses decreased from 31 percent to 18 percent between 1957 and 2001.[40] Agricultural land is used primarily for vineyards, Christmas trees, citrus trees, berries, deciduous orchards, and pasture in El Dorado County; and rice, walnuts, cattle and calves, nursery, and pasture and range in Placer County.[41]

The effects of urbanization and suburbanization are increasing in the CABY region, as the population growth of the region is outpacing that of the state. Presently, urban areas only constitute 1.4 percent of

[40] Walker et al. 2003
[41] Placer County RCD

the land cover in the CABY region but this is expected to change as the region accommodates a large increase in population per projections from Department of Finance/Department of Water Resources. Growth in the CABY region will affect the extent of open spaces and cause significant impacts on natural resources.[42] At the same time, it brings with it a larger tax base to pay for essential community services which are otherwise limited in rural areas. With the elimination of traditional land uses such as timber harvesting, farming, and ranching, local rural economies are more dependent on development- and tourism-related revenues.

5.3 CABY Region – The Social and Cultural Environment

5.3.1 Social and Cultural Attributes

The scenic beauty and abundant recreational opportunities in the CABY region attract nationwide tourism. Popular activities include mountain biking, boating, swimming, fishing, and hiking in the summer, and downhill skiing, snowmobiling, and cross-country skiing in the winter. The South Fork American River is one of the most popular whitewater runs for rafting and kayaking in California. Recreational opportunities are more limited in watersheds where the landownership is primarily private, such as the Bear River watershed.

The cultural resources of the Sierra Nevada are some of the main assets that attract people to the area, and have contributed to our knowledge and understanding of California prehistory. The value of these assets is immeasurable, but more importantly, these resources cannot be replaced once they are destroyed. Archaeological resources, such as prehistoric and historic artifacts, buildings and other cultural objects, are distinctive and unique features of this landscape.

5.3.2 Economic Conditions and Trends

The growing metropolitan population in the Sacramento area is spilling into the CABY region, fueling demand for water and other natural resources. An increase in the population over the past decade can be attributed to an increase in professional services, industries, and residential developments. Population centers are mostly in the foothills of the Sierra Nevada and along the major Sierra highways (Highways 49, 50, and 80).

Current population figures for the CABY planning area are estimated at 450,000. The population has increased substantially in the area, with a 41 percent increase in Placer County from 2000 to 2010 — the fastest growing county in the Sacramento Metropolitan Region and exceeding average growth rates for the Bay Area and for California as a whole. Placer County is projected to grow approximately 23 percent between 2010 and 2020.[43] El Dorado County also experienced a significant increase, with a 17.6 percent change in population from 1999 to 2009.[44] Nevada County, which has a generally smaller population and economy, grew at 7.7 percent between 2000 and 2009. From 2009, Nevada County is projected to grow 13.8 percent by 2015.[45] The slowest growing county was Yuba with a three percent population change between 2000 and 2010.

The CABY region is a contributor to the economy of the Sacramento Metropolitan Region. Traditionally, jobs in the CABY region were focused in areas of agriculture, timber, and mining. Over the past few

[42] Sierra Nevada Ecosystem Project 1996
[43] Center for Strategic Economic Research 2011
[44] SACTO 2010
[45] CED 2010

decades the economy has been shifting to services, manufacturing, and technological industries. Professional and business services, financial activities, construction, trade, transportation, and utilities make up the majority of the industry sector. Natural resources and extractive industries have decreased in both economic makeup and percent of job contributions in the past 10 years, and are now a small part of the industry sector.

The business community in Placer County, for example, is generally growing at a greater pace than the rest of California. The county specializes in educational and health services and trade, transportation, and utilities. Before the housing bust, Placer County was an employment leader in the construction sector; it is likely that this will rebound with the economy. Nevada County reported that 46 of the businesses within the county in 2008 offered some type of service to their customers, making the services sector the most prominent industry in Nevada County. Construction and retail came second and third, with 16 and 14 percent of the business in the county, respectively (mirroring the state).[46]

Employment in the CABY region tracks generally with the state as a whole. While Placer County increased its labor force 49 percent between 2000 and 2009 (higher than the Sacramento Region, Bay Area, or California), its unemployment rate in 2009 was 10.6 percent. Information from the 2009-2010 Economic Profile (CED 2010) indicates a slight uptick in Nevada County unemployment numbers in 2008, similar to California as a whole, and the last year that unemployment information is available for the county.

Tourism is an extremely important contributor to economic activity in the Sierra Nevada; this is especially true in the CABY region. Nevada County reports that the total annual travel expenditures within the county rose by 28 percent between 2000 and 2007, slightly higher than the percent gain between those same years by California as a whole. This translates to approximately 3,400 travel-generated jobs in Nevada County in 2007, or 5.7 percent of the total workforce.[47] El Dorado County estimates for recreation and tourism income in 2008 are over $604 million, and the leisure and tourism industry has been the highest employer in the county since 1995.[48] The agricultural output in El Dorado County included over $16 million in fruit and nut production, including nearly $6 million in wine grape production in 2010.[49] Additionally, agricultural tourism has grown in the last decade. Destinations such as Apple Hill in El Dorado County bring in about $20 million per year and generate approximately 200 jobs for the region,[50] and agricultural activities in Placer County contributed over $65 million in gross production in 2010.[51] These activities also bring in tax revenues to city and county general funds, paying for the important services enjoyed by residents of the region, as well as providing employment for a percentage of the workforce.

5.3.3 Disadvantaged Communities (DACs)

5.3.3.1 Definition of DAC Based on DWR Guidelines

In the IRWMP process, a DAC is defined as a community with an annual median household income (MHI) less than 80 percent of the statewide annual MHI. Based on the 2010 Census, 18 communities within the CABY region are now identified as DACs (MHI is $48,706 or below). The statewide annual MHI in

[46] CED 2010
[47] CED 2010
[48] CED 2011
[49] County of El Dorado, 2011
[50] Sacramento Regional Research Institute, 2008
[51] Placer County 2010 Crop Report, available here: http://www.placer.ca.gov/Departments/Agriculture/AgrCropRpts.aspx

California in 2010 was $57,708.[52] The communities in the CABY region that qualify as DACs are listed below in Table 5-5 and in Chapter 2 Table 2-5. The communities that meet the DAC definition have changed with the most recent census data in the following ways:

- Fourteen communities not previously identified as DACs are now considered DACs: River Pines, Kirkwood, Grizzly Flats, Soda Springs, Washington, North San Juan, Rough and Ready, Newcastle, Downieville, Alleghany, Camptonville, as well as parts of Graniteville, Pike, and Dobbins. This change is due in part to the new census data, and in part to the most recent assessment using a broader scope (the earlier assessment was not sufficiently broad).
- Four communities identified as DACs in the earlier assessment are still considered DACs with the 2010 data: Plymouth, Grass Valley, Penn Valley, and North Auburn.
- Seven communities previously defined as DACs no longer meet the DAC criteria: Palermo, Diamond Springs, Placerville, Nevada City, Foresthill, Colfax, and Challenge-Brownsville.

Communities listed below are considered disadvantaged (less that 80 percent of the California median household income).

Table 5-5
Communities in the CABY Region Designated as Disadvantaged

County	Census Places	MHI
Amador	River Pines	$ 9,918
	Plymouth	$ 31,250
El Dorado	Kirkwood	48,155
	Grizzly Flats	32,173
Nevada	Soda Springs	40,757
	Graniteville (between Alleghany and Washington on Meadow Lake Road)	-
	Washington	17,566
	North San Juan	29,145
	Grass Valley	35,385
	Rough and Ready	39,020
	Penn Valley	47,530
Placer	Newcastle	29,324
	North Auburn	44,372
Sierra	Downieville	48,125
	Alleghany	22,188
	Pike	26,429
Yuba	Dobbins (just east of Oregon House)	42,946
	Camptonville	27,031

Water management decision-making sometimes ignores the historic, economic, environmental, and social burdens of disadvantaged communities. These communities reside amid the economically viable

[52] American Fact Finder: http://factfinder2.census.gov/; accessed 2/2012

water infrastructure, but rarely directly benefit from the economics of water resource supply and demand. Therefore, as part of this IRWM planning process, these DACs will be assisted in identifying their water and natural resource needs. Disadvantaged community members participate as stakeholders in the public forum to influence decisions that will be of economic benefit to them. Such benefits may focus on recreation revenue generating plans, or water development projects that can improve local employment and quality of life.

5.3.4 Collaboration with Tribal Governments

Note: Updates and additions to this section are expected during this review period with assistance from Tribal interests. A further description of how CABY has worked with Tribes can be found in Chapter 2, Stakeholder Outreach.

The CABY region's landscapes were shaped by a wide variety of human activities over thousands of years. These watersheds were used by Native Americans to hunt and gather; burning in the valleys and meadows was also a common practice to clear hunting grounds. Native American tribes occupying the lower slopes of the western Sierra Nevada at the time of contact with European-based cultures were the Hill Nisenan or Southern Maidu, and the Sierra Miwok. Many were killed or displaced by contact with the Spanish in the 1700s (mostly from disease) and by later Euro-American settlement.[53] Today, identified Indian Tribes and/or residents in the CABY region include the Washoe Tribe of Nevada and California, the Shingle Springs Band of Miwok Indians, the Tsi-Akim Maidu, and the Colfax-Todds Valley Consolidated Tribe. The Tribal entities who were contacted during the CABY outreach process are discussed in Chapter 2, section 2.1.3.

American Indians continue to use the region for traditional uses, including basket weaving and ceremonial harvests by the Tsi-Akim. However, the availability of materials is contingent on the health of the watersheds in which they grow. A description of how CABY has worked with Tribes and future efforts and plans can be found in Chapter 2, Stakeholder Involvement.

5.3.5 Regional Cultural History

The region's landscape has been shaped by a wide variety of human activities over thousands of years. These watersheds were used by American Indians to hunt and gather; burning in the valleys and meadows was also a common practice to clear hunting grounds. American Indian tribes occupying the lower slopes of the western Sierra Nevada at the time of contact with European-based cultures were the Hill Nisenan or Southern Maidu, and the Sierra Miwok. Many were killed or displaced by contact with the Spanish in the 1700's (mostly from disease) and by later Euro-American settlement. Today identified Indian Tribes and/or residents in the CABY region include the Washoe Tribe of Nevada and California, the Shingle Springs Band of Miwok Indians, the Tsi-Akim Maidu, and the Colfax-Todds Valley Consolidated Tribe.

Though many of the American Indian artifacts were destroyed by placer mining, there remain important archeological resources in the region. Evidence of prehistoric uses in the area, such as prehistoric camps, along with more recent activities, such as pioneer trails, bridges, mining features, and logging camps, can be found throughout the region that testify to the historic uses of the area and the need to protect these important cultural sites. American Indians continue to use the region for traditional uses, including basket weaving and ceremonial harvests by the Tsi-Akim, however, the availability of materials is contingent on the health of the watersheds in which they grow.

[53] BLM 2004

The discovery of gold at Sutter's Mill along the American River in 1848 led to the California Gold Rush of 1849 and played an important part in U.S. history. There are over 1,500 gold rush era historic and American Indian cultural sites in the American River canyons, many of which are eligible for inclusion on the National Historic Register.[ii]

5.3.6 Native American Tribes

People have been attracted to CABY region water sources for millennia. Native American Indians were attracted to water sources such as rivers and lakes in the SFAR watershed for the purposes of sustenance and places of spiritual gathering. Watersheds throughout the region were used by American Indians to hunt and gather; burning in the valleys was also a common practice to clear hunting grounds. The American Indian tribes occupying the lower slopes of the region at the time of contact with European-based cultures were the Hill Nisenan or Southern Maidu, and the Sierra Miwok. These Tribes had many social gathering sites throughout the region – often close to rivers and streams. Ceremonies and rituals related to the seasons and harvesting of food took place at these social gathering sites where the Indian Tribes made customized basketry, feather robes, and other elaborate ceremonial costumes.[iii]

The cultural resources of the Sierra Nevada are some of the main assets that attract people to the area. In addition, the cultural resources found in the watershed have contributed to our knowledge and understanding of California prehistory. The value of these assets is immeasurable, but more importantly, these resources cannot be replaced once they are destroyed. Archaeological resources, such as prehistoric and historic artifacts, buildings and other cultural objects, are distinctive and unique features of this landscape. These resources add to the spirit and ambiance of the small communities located in the watershed.

[i] Sierra Nevada Ecosystem Project 1996
[ii] Friends of the River 2006
[iii] GDRCD 2003